

"Searching for the Top Range in Early Nineteenth Century Bassoon Repertoire from Sweden: Issues of Material and/or Technique?"

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Introduction

It is not uncommon to find a range of three full octaves in late eighteenth century and early nineteenth century bassoon repertoire, but passages ascending *above* $b^{b'}$ or c' were relatively rare. Composers active in Stockholm at the beginning of the nineteenth century such as Bernhard Crusell, Eduoard Dupuy, Franz Berwald and Eduard Brendler wrote pieces encompassing a range of Bb – to $e^{b''}$, inspired by the Preumayr brothers, in particular the youngest, Frans Preumayr, who was an internationally known soloist and principal bassoonist in the Swedish Royal Orchestra from 1811–1835.

In conjunction with my current PhD research in the docARTES program at Leiden University and the Royal Conservatoire in the Hague, dealing with early nineteenth century bassoon repertoire in Sweden, one of my goals was to discover the means of reaching these top notes and integrating them into a fluid technique which would enable historical bassoonists to perform this extraordinary repertoire composed for the virtuoso Preumayr. I wondered if the keys to the high register might be found in a special reed type, or a physical technique involving, for example, jaw position? Was Frans Preumayr's ability dependent on a particular model of bassoon? Or could other factors be involved that I hadn't yet considered?

Two repertoire examples:

I. Noteworthy here, in Franz Berwald's "Konzertstück für Fagott und Orchester", composed for Preumayr in 1827, is the $e^{b''}$, found twice, in measures 206 and 208:

From: Andante, measures 206-08¹:



II. Note the high e^{\flat} in measure 249 from the first movement of Édouard Dupuy's *Konzert Es Dur* (C moll), which was premiered in Stockholm on January 12, 1805.²



An Instrument from Dresden, located in Sweden

My interest in this repertoire stemmed from an instrument that I had acquired in 1985: an eleven-keyed Grenser & Wiesner bassoon with two wing joints, with three crooks, case, six reeds in a reed box initialed "C.J.F.", and the original instrument case. Not only in perfectly playable condition, it is one of the few surviving complete and intact historical bassoons located thus far. A partially legible address label on the case indicates that the instrument, constructed around 1822, was sent to Sweden from its origin in Dresden. Although I have not yet been able to determine who played this bassoon, it is evident from the wear around the tone holes that the instrument had been used extensively but was nonetheless well-preserved.



Grenser & Wiesner Bassoon, ca 1822, Dresden

The Popularity of Grenser Instruments in Sweden

In an article written about the Dresden workshops, Phillip T. Young points out, "*Grenser & Wiesner instruments are numerous and especially so in Sweden, where perhaps half the surviving instruments are found*".³ Many other Grenser woodwind instruments have been located in Stockholm and their popularity may be due to the fact that Johann Friedrich Grenser, son of the woodwind instrument builder Karl August, was employed as an oboist in the Royal Orchestra in Stockholm and may have established a lucrative business contact already in the 1780s.⁴ As so many of these instruments have been found in Sweden, with evidence that other woodwind players at the court also used Dresden instruments, I believe that a certain aesthetic and taste prevailed there and that Preumayr could have very well used such a bassoon.⁵

Original Crooks and Reeds

Although numerous examples of fine bassoons from the past are extant, the small but most crucial parts—reeds and crooks—are almost never located intact.⁶ Therefore, the existence of the six reeds and three crooks found together with my bassoon was no less than an incredibly valuable find which I hoped might ultimately give me clues about reaching the top register notes needed to play the Scandinavian bassoon literature. Even if reed styles vary markedly from player to player, a complete set up of historical reeds, crooks and instrument still offers a substantial amount of information. The exact pitch of an instrument, tuning, tone color, response and range all depend on the qualities and dimensions of the reed made of *Arundo donax* that enables the bassoonist to produce a sound, as well as on the dimensions of the metal crook.

Three Original Crooks

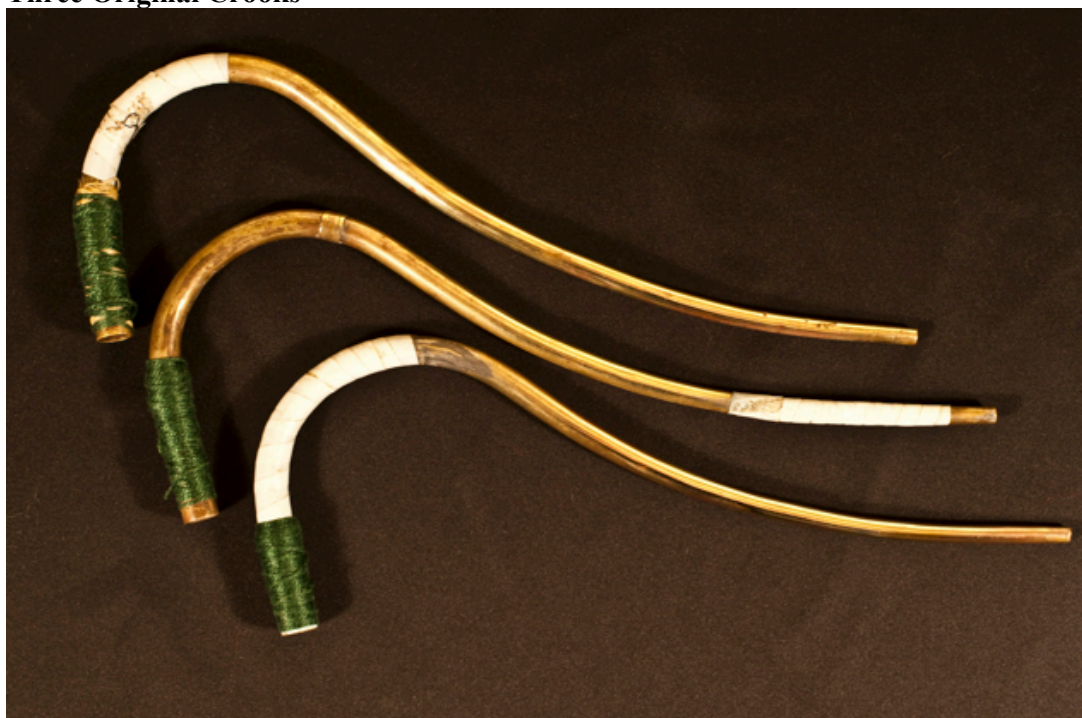


Photo by Annelies van der Vegt

(From top to bottom, nos. 1–3)

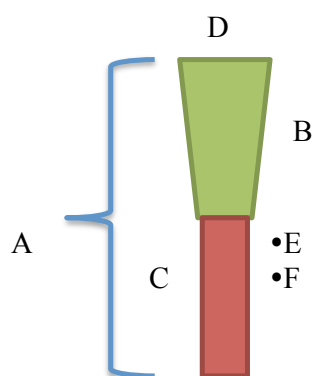
	Length	Weight	Smallest Diameter	Largest Diameter
1.	311 mm	27 gr	4.45 mm	8.9–9.0 mm ⁷
2.	326 mm	27 gr	4.45–4.5 mm	9.7 mm
3.	326 mm	25 gr	4.45–4.5 mm	9.4 mm

The three brass crooks are very similar to each other and presumably made with the same mandrel, but in two different lengths.⁸ They are considerably longer and lighter than most current copies being used, and made to a thickness of ca 0.5 mm. One of the crooks, no. 2, has been repaired with an additional band of ornamented brass. Originally, none of the crooks had a pinhole, but I added one later on no. 2 for experimental purposes.⁹ Present-day crooks for classical bassoons are generally constructed from brass with a thickness of at least 0.8mm or more, and are shorter and heavier, with a pinhole. Players often use longer and bigger reeds than those supplied with my Grenser & Wiesner bassoon, coupled with shorter crooks than those described above.

Six Reeds and Reed Box "C.J.F."



Photo by Annelies van der Vegt



Reed (from left to right)	Total length A	Blade length B	Tube length C	Tip Width D	1st wire E Ø	Above wrapping F Ø
1.	57.36	27.08	30.28	15.00	8.17	7.62
2.	56.50	25.58	30.92	15.10	8.05	7.20
3.	58.30	28.10	30.20	13.90	8.10	7.5
4.	57.55	26.90	30.65	13.60	7.90	7.35
5.	64.90	26.80	38.10	13.10	8.68	7.30
6.	66.55	26.65	39.70	14.38	9.29	-

Previous Surveys of Historical Reeds

In 1984, Paul White published a survey of 28 historical reeds with very detailed measurements, drawings and descriptions.¹⁰ In only three cases of White's survey could reeds definitely be associated with a particular instrument, an 8-keyed Milhouse bassoon from the Waterhouse collection. Some other examples had previously been connected to instruments from Jehring, Rust and Winnen, but unfortunately were later separated and are no longer completely identifiable as such. White additionally summarizes five historical sources of early reeds found in methods or treatises, from 1761 to 1842. Additionally, in articles published several years later by White and Greg Lehey, more reeds from the eighteenth and nineteenth centuries are described, but none with overall dimensions very similar to the "*C.J.F.*" reeds in my possession.¹¹

White states that some of the reed specimens he examined have evidently been shortened, a technique commonly used to prolong the life of a reed.¹² No evidence however exists which can prove this is the case with the "*C.J.F.*" reeds considered here. The dimensions of the relatively short "*C.J.F.*" reeds with the accompanying crooks of these lengths does not come so unexpectedly, as longer crooks require shorter reeds, and vice versa. Some secondary measurements of the blades and diameters of the tube are within the ranges of the reeds examined by White and Lehey.

Initial Reed Experiments

I decided to experiment with replicas inspired by the "*C.J.F.*" reeds to see if the high register could be specifically and favorably influenced. I admit that when I initially acquired them, the dimensions of these reeds seemed so radically different from what was previously known, that I hardly considered copying them. The longer I played the Grenser & Wiesner bassoon and experimented to find the ideal response and tone however, the more my own reed measurements evolved towards the dimensions of these originals, finally reaching similar lengths in tube and blade; that is, my own reeds gradually became shorter.

The notes above c' however, were still not reliable enough, if at all even possible. Discrepancies between the "*C.J.F.*" and my reeds existed in the blade shape, the diameters

in the reed tube, surface scrape and number of wires. Even if the performance qualities of the original reeds cannot be determined, or it is unknown if they reflect Preumayr's reed making style, I wondered if these were critical factors that would enable the extension of range to three and a half octaves.

My first attempts at duplicating the old reeds were very positive; it was actually possible to screech out the very top notes up to e^b" and I was elated with these early results. I soon realized however, that the tone quality was far from being ideal, and it certainly wasn't possible yet to play these notes with real ease. I suspected that the material and reed size were mismatched; *the cane was possibly too hard or dense for these dimensions*. They would have to be altered somewhere in order to produce an optimal sound, yet maintaining the large range from top to bottom. Another variable concerned the scrape style: the "C.J.F." reeds had some bark on the blades, whereas in a modern scraping style, this is removed entirely.

Cane Density/Hardness and Reed Scraping Styles

Two important aspects in the reed making process should be taken into account: the material used and the process chosen to thin the raw material down to a useable reed. Recent research concerning climate change and cane density confirms that reeds for woodwinds may vary considerably even from one year to the next, because of changing environmental conditions.¹³ David Rachor, in an article on the subject of cane selection and bassoon reeds, states that the material used to make reeds in previous centuries was considerably softer or less dense than that which we use today.¹⁴ Rachor correctly suggests that replicas of 'internally gouged' reeds made with cane currently available may not function or sound as the original models did. In the process of 'internal gouging', wood has been removed from the inside of the piece of cane and bark remains on the sides of the blades.¹⁵ Simply *copying the appearance* of the reed scrape, however, is not sufficient to judge its real functionality; it is feasible that with today's harder material, *a different technique, using the less dense layer of cane* must be used to obtain an end product which functions well with a nineteenth century instrument. In another article, Rachor discusses adjusting reed making technique to suit the material and vice versa, an issue that deserves to be considered by historical bassoonists today. An ensuing question

is the reason why bassoonists or reed makers eventually stopped using the older internal gouging technique. Why change something that works?

Geoffrey Burgess noted the technological developments of gouging machines that contributed to the revolutionized (oboe) reed making business in the nineteenth century, and it would be clearly simplistic not to consider the evolution of instrument making, changing tastes and musical demands in a discussion of reed construction and history.¹⁶ It is logical, however, to assume that reed-making techniques were also adapted to accommodate the changing material, and most importantly, to ensure that reeds would function. The significance of these developments should be considered in reed making practices today and taken into account by musicians playing historical woodwind instruments.

Cane Density and Hardness

By measuring density and hardness of cane, I wanted to investigate the range of these two factors in a few sample groups from three different producers of *Arundo donax* taking ten tubes from each sort.¹⁷ Clearly I could not compare these measurements with cane from the nineteenth century, but how large was the range of variation in hardness and density in a sampling of contemporary cane? Would this range warrant leaving or removing bark on the blade ('internal gouge' / 'modern scrape'), and would these variations influence the top notes?

1. The cane was split into three pieces; relative density was measured and noted for each piece. This was done using a scale accurate to 100th/ of a gram, with a method displacing water with cane. The following formula, known as the "Heinrich Cane Density Test" was used:

$$\text{Relative Density} = M / M1 - M2$$

(M = cane weight; M1 = cane, dry, on rack; M2 = cane, submerged in water)¹⁸

Relative Density of Sample Groups (30 pieces)
Scale: Low figure (= less dense) to high figure (more dense)

	Range
Marca:	0.39–0.58, mean RD = 0.475
Madame Ghys:	0.39–0.48, mean RD = 0.408
Medir:	0.36–0.52, mean RD = 0.441

2. The pieces were gouged to a thickness of 120 mm using a Reeds 'n Stuff custom gouger; hardness was measured using a Reeds 'n Stuff digital hardness tester, which presses a lever into the cane and measures the resistance against it. Three measurements were taken: one from each end and in the middle; the average was then calculated to arrive at a middle value indicating hardness or resistance.
Scale: Low figure (= harder) to high figure (= softer).

Range of Hardness
Scale: Low figure (= more hard) to high figure (= less hard)

Marca:	17.0–28.3, mean H = 22.04
Madame Ghys:	16.3–32.0, mean H = 21.15
Medir:	15.6–39.6, mean H = 24.23

How useful was this information? There was a more-or-less similar range of density (and correlating hardness) in all three groups of cane samples; with wider variation in some. I realized that the conclusions I had hoped could be draw from this data would not be very significant; furthermore, the peculiarities of an individual piece of cane could never again be duplicated in following experiments. This time-consuming process might prove to be impractical in the daily lives of most reed-making performers. Being able to identify qualities of hardness, density and flexibility is clearly advantageous, but there are other more simple means of comparing these factors which can be carried with no special equipment, as described by James B. Kopp in a

comprehensive article about reed cane published in 2003.¹⁹ An exercise of this nature can, however, serve to train and sensitize the reed maker to the extent that recognition of these qualities is more immediate and intuitive.

Continuing with the reed constructions, I decided to remove the bark in the blade area with the hardest pieces, using a 'modern scrape', and a partial 'internal gouging' when using the softer pieces, imitating the construction of the original reeds. Experience had already taught me that reeds constructed from harder cane would require alterations in dimensions (as mentioned above, my first attempts copying the dimensions of the historical reeds had produced an inflexible sound), so I was careful to make the area around the wires not quite as narrow as the original reeds.²⁰ I used 0.6 mm soft brass wire and a thread wrapping covered with nail polish to finish. Initially, I placed only two wires on the reeds, instead of three, imitating the construction of the "*C.J.F.*" reeds. During the scraping process however, I found it too difficult to maintain control of the reed tip opening and therefore added a middle wire, which eliminated that problem.²¹

Even after just a few reeds were finished, tested and played in, I noticed that each one, although having typically unique characteristics, was invariably 'better than average', ranging to 'very good'; furthermore, the highest notes were possible, and the lowest register had also improved, with no compromise of tone quality over the entire register. My overall percentage of useable reeds had markedly increased. I continued constructions, noting that I was instinctively reacting to the qualities of the material in a better and more perceptive manner in each finishing step than I had previously. While reed dimensions are by nature highly individual, the following chart illustrates the range of some successful examples:

Reed Name	Total length A	Blade length B	Tube length C	Tip D	1st wire E Ø	2nd wire F Ø
7G	55.60	27.37	28.23	15.57	8.66	7.50
17G	55.45	26.54	28.91	15.40	9.12	7.65
21G	56.25	26.58	29.40	15.44	9.00	7.49
25G	54.31	25.94	28.37	15.70	9.00	7.36
30G	55.98	27.56	28.42	15.24	9.54	7.81

A similar, more extensive experiment dealing with cane hardness was conducted by oboists from the University of Wisconsin in Eau Claire and documented in an article by Christa Garvey in 2012.

"...we learned that the relative cane hardness range that we had did not inhibit us from making usable reeds....In addition to our scientific findings, we found we gained a better understanding of cane processing, developed a wider curiosity of the many variables in reed making, and became more experience, efficient and independent reed makers."²²

This re-enforces my belief that an *intuitive approach* to reed making, supported by the necessary theoretical knowledge and understanding of the material at hand, are the most valuable tools required to consistently construct excellent reeds. The most important result of this exercise for me was the development of a more defined intuition about characteristics of the cane during the entire process, leading me in the direction towards obtaining a range of three and a half octaves, with the priority of maintaining tone quality from top to bottom.

Significantly, once I 'knew' that the highest notes were in reach, most of the reeds I constructed from the sample groups of cane also seemed to produce at least a d", if not the top e^b", as well, regardless of my choice of partial 'internal gouging' or 'modern scrape'. Gradually, and over a period of a few months, it became apparent that it was not necessary to construct a special reed with qualities favoring *only* the high register, as in my earlier attempts. This is advantageous in that the tone quality over the entire range of the instrument is intact, and the reed is adjusted to obtain both highest and lowest tones.

Many different aspects are taken into account during the entire reed making process: balancing several priorities, making compromises and making fine adaptations until a final, optimal result is reached.²³ It is not my intention to go into detail about these adjustments within the scope of this report, nor do I have the necessary expertise to do so; thorough explanations and illustrations can be found in excellent articles concerning the physics involved in bassoon reeds written by James B. Kopp.²⁴

Physical Aspects

Parallel to the intensive reed experiments, I was also attempting to refine the quality of the highest tones; I had, after all, been able to reach them some months earlier, albeit in a somewhat primitive manner, using reeds from the earliest experiments. Physical processes involved, such as embouchure, head and jaw position, had to be observed and analyzed.

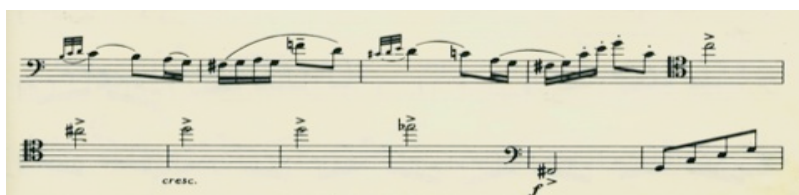
A student who was working on perfecting the c' with a physical therapist reported that the head position seemed to influence how well she could produce this tone. She noticed that if she consciously pulled her head *slightly* towards the back, at the same time keeping the jaw relaxed, she could attack the note more cleanly and consistently. A few months later, she successfully performed a sonata requiring several high c's, with a bassoon pitched at A=415 Hz.²⁵

In general, any pressure from the embouchure ("biting") or upward jaw position proved to be detrimental. Our experimentation with different physical positions and embouchure in my classes continues; clearly this must be tailored to individual physique, as variations in individual air and lip pressure play important roles.

Conviction of the Possibility

Another aspect about training production of the high notes was striking: when *convinced* of the possibility, the tones become considerably easier to produce. Looking back on my own learning process involving these highest notes, I realized that previously, I been substantially hindered by a belief system dictating that the range of my instrument extended no higher than b^b, or c". When one is convinced that a task is possible and sees evidence of it being done well and easily, it loses a great degree of its difficulty; the opposite is also evident.

The power of a belief system became even more apparent when another student, unfettered by the idea that notes above the b^b on a historical bassoon could be at all 'problematic', performed the DuPuy Quintet in A minor, ascending chromatically to the e^b twice, using an anonymous original French instrument and reeds having longer measurements than the "C.J.F." reeds. No one had ever told him this was difficult or that he needed specific materials to play these tones.



Measures 115–125, from the third movement of "Quintet für Fagott und Streicher" by Édouard Dupuy²⁶

Other similar events in my two classes in Basel and the Hague were observed over the last year, as students learned to extend their range after seeing a demonstration of the production of these tones. This approach, in combination with identifying and breaking down individual barriers concerning range, seems to influence the learning process quite effectively. I will certainly investigate this topic further in the context of my dissertation.

Fingerings

The fingerings for the highest register on the Grenser & Wiesner provided below proved to be the most successful in the end, although several options are possible, depending upon the player and reed. They appear to function on other model bassoons (both copies and historical) that we have thus far tested.²⁷ Undoubtedly others will surface.

(w = wing keys; C, D, E holes; Eb, F#, F, Eb, Ab keys on G&W)

b'	c''	c#''	d''	e^{b''}
W2 1 2 4 5 F	W2 1 C 2 D 4 5 E F	W 1 or W2 1 (C) 3 (D) 4 6	W2 1 (Eb) (F#)(Ab)	W3(2) Eb F# Ab

Conclusion

Although it is not clear if any single technique or material had more impact on the results of this research, my initial goal to find solutions for production and performance of the highest notes has been reached and can be refined further. Additionally, students and colleagues working on this issue are more and more able to obtain similar positive results. I have not yet finished constructing reeds made of all the pieces of cane in the sample groups of my hardness/density test, nor was any conclusive evidence generated about specific reed measurements which can provide a guarantee for the highest tones, but it is evident that my reed making technique clearly improved as my sense of recognition of cane qualities increased. A reed maker for more than forty five years, I noted that I have developed more intuitive sensitivity about the material, resulting in a higher number of useable reeds. I am able to describe various details of the reed making process more fluently to my students and an active dialogue is encouraged as we continue to experiment and report our findings.

Issues involving 'internal gouge' vs. 'modern scrape' have not been, nor ever will be conclusively resolved; the question concerning the usage of two or three wires has also not yet been completely addressed. These are all matters of individual preferences and tastes of tone color and response, just as they were in earlier centuries. In an article about early reeds from 2001, Rainer Weber describes two main reed-making styles in the eighteenth and nineteenth centuries: "Paris-London", "Saxon-Berlin", and refers to yet a third style, found in Copenhagen and Stockholm, built on a metal staple. But he wisely acknowledges:

*"There was no absolute standardization of external shape! There existed a far-reaching and individual range of possibilities, each according to the tonal conception of the player, as well as to the peculiarities of the instrument and the material. . . . Together with the considerable differences in design of instrument between the French and German systems that still persist, there were thus also basic differences in the design of reed, not only within the confines of country but individually between player and player."*ⁿ²⁸

The influence of the relationships of reed and crook measurements require ongoing and extensive experimentation, and may eventually prove to be another crucial factor in extending the high register. I am confident that additional knowledge of physical aspects, such as adjustments in head position, coupled with the strong

psychological 'power of possibility' will also enable more historical bassoonists to explore Preumayr's repertoire, as the highest register becomes more accessible.

New questions have now arisen: Was Frans Preumayr alone with his ability to play three and a half octaves in the early 1800s? If so, why? It appears that composers other than those writing for this virtuoso did not exploit the high register until late in the nineteenth or the beginning of the twentieth century, even though the instrument went through radical changes after the mid-1850s, presumably expanding its range.

Endnotes

¹ {Berwald, 1984 #47}

² Édouard Dupuy, 'Konzert Es-Dur für Fagott und Orchester', (Wargau: Accolade Musikverlag, 2009).

³ Phillip T. Young, 'Inventory of Instruments: J.H. Eichentopf, Poerschman, Sattler, A. and H. Grenser, Grundmann' *Galpin Society Journal* 31/May (1978), 108.

⁴ Allgemeine deutsche Biographie, Bd.:9, Geringswald-Gruber, Leipzig, 1879, 639. URL: <http://daten.digital-sammlungen.de/bsb00008367/images/index.html?seite=661>. Last accessed 12.11.2013.

⁵ For example: Preumayr's colleague and father-in-law, the clarinetist and composer Bernhard Crusell, played a Heinrich Grenser clarinet from Dresden, ca 1810, currently exhibited at the Musik- & Teatermuseum in Stockholm. (Museum no. N43554)

⁶ Bruce Haynes and Hansjürg Lange, 'The Importance of Original Double Reeds Today', *Galpin Society Journal* 30/May (1977), 146.

⁷ Here there is a small contraction, due to repair.

⁸ The mandrel is the tool on which a sheet of brass is formed into a tube and then soldered together on a seam.

⁹ This is commonly known as the "whisper key hole" today, used to facilitate the over-blown C and D octaves.

¹⁰ Paul White, 'Early Bassoon Reeds: A Survey of Some Important Examples', *Journal of the American Musical Instrument Society* 10 (1984), 69-96.

¹¹ ———, and another, written by Greg Lehey, 'More on 19th Century Bassoon Reeds', *FoMRHI Quarterly*, no. 58/January (1990), 34.

¹² ———, 'Bassoon Reeds by Triebert and Massabo', *FoMRHI Quarterly*, no.56/July (1989), 29.

¹³ Kirsten M. Boldt-Neurohr, 'The Proof Is in the Playing - the Affects of Climate During Cultivation on *Arundo Donax*' - Part V', *Double Reed* 34/4 (2011), 89-97.

¹⁴ David J. Rachor, 'The Importance of Cane Selection in Historical Bassoon Reed-Making', *Galpin Society Journal* 57/May (2004), 146.

¹⁵ For a detailed description of the internal gouging technique, see White's section on scraping methods: White (1984), 70-71.

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- ¹⁶ Geoffrey Burgess and Peter Hedrick, 'The Oldest English Oboe Reeds? An Examination of Nineteen Surviving Examples', *Galpin Society Journal* 42/August (1989), 66. Further, conversations about the development of reed making techniques with Geoffrey Burgess and Frank de Bruine, in The Hague, January 16, 2012.
- ¹⁷ The sample cane came from two French suppliers, MARCA and Madame Ghys, and one Spanish supplier, Medir.
- ¹⁸ See David Rachor's website: URL: http://www.uni.edu/~rachor/art_baroque_heinrichdensity.html. Last accessed 10.11.2013.
- ¹⁹ James B. Kopp, 'Counting the Virtues of Bassoon Cane', <http://koppreeds.com/virtues.html>, last accessed November 14, 2013.
- ²⁰ This area tends to shrink with age and influences tone quality. By slightly increasing the diameter here, a rounder tone quality can be obtained.
- ²¹ Several students have constructed some well-functioning reeds using only two wires. We are experimenting further to improve control of the tip opening, and to see if there are any clear advantages in using only two wires, as opposed to three.
- ²² Christa Garvey, 'Effects of Relative Cane Hardness on Oboe Reeds: A Student-Faculty Collaborative Research Project from the University of Wisconsin, Eau Claire', *The Double Reed*, 35/3 (2012), 93.
- ²³ A simple example: if the cane is weaker or softer, more tension can be given by tightening the wires.
- ²⁴ James B. Kopp, 'Physical Forces at Work in Bassoon Reeds', *The Double Reed*, 26/No. 2 (2003), 69-81. A second, more recent article: 'Tube, Tip and Aperture: The Functional Geometry of your Bassoon Reed', *The Double Reed*, 36/No. 3, 69-78.
- ²⁵ The student played on a Prudent model bassoon made by Laurent Verjat, and performed the Sonata No. 3 by Antoine Dard in her final recital.
- ²⁶ Édouard Dupuy, 'Quintett in a-moll für Fagott und Streicher' (Hamburg: Musikverlag Hans Sikorski, 1973). The third movement was actually composed by Carl Anton Philipp Braun (1788-1835), an oboist in the Royal Orchestra in Stockholm at the same time as Preumayr.
- ²⁷ We have used Grenser copies constructed by Orriols, de Koningh, Ross; a Verjat Roost copy, an anonymous nineteenth century French bassoon, in addition to my Grenser & Wiesner.
- ²⁸ Rainer Weber and William Waterhouse, 'Early Double-Reeds', *Galpin Society Journal* 54/May (2001), 238-39.

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